

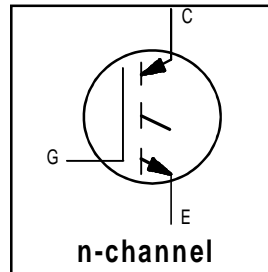
# IRG4BH20K-L

INSULATED GATE BIPOLAR TRANSISTOR

Short Circuit Rated  
UltraFast IGBT

## Features

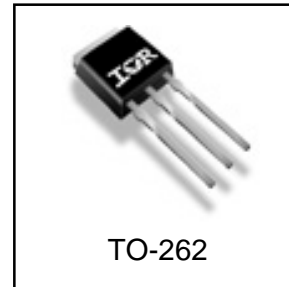
- High short circuit rating optimized for motor control,  $t_{sc} = 10\mu s$ ,  $V_{CC} = 720V$ ,  $T_J = 125^\circ C$ ,  $V_{GE} = 15V$
- Combines low conduction losses with high switching speed
- Latest generation design provides tighter parameter distribution and higher efficiency than previous generations
- Industry standard TO-262 package



$V_{CES} = 1200V$
$V_{CE(on)} \text{ typ.} = 3.17V$
@ $V_{GE} = 15V, I_C = 5.0A$

## Benefits

- As a Freewheeling Diode we recommend our HEXFRED™ ultrafast, ultrasoft recovery diodes for minimum EMI / Noise and switching losses in the Diode and IGBT
- Latest generation 4 IGBT's offer highest power density motor controls possible



## Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	11	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	5.0	
$I_{CM}$	Pulsed Collector Current ①	22	
$I_{LM}$	Clamped Inductive Load Current ②	22	
$t_{sc}$	Short Circuit Withstand Time	10	$\mu s$
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$E_{ARV}$	Reverse Voltage Avalanche Energy ③	130	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	60	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	24	
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to +150	$^\circ C$

## Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	2.1	$^\circ C/W$
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	40	
Wt	Weight	6 (0.21)	—	g (oz)

**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA
V <sub>(BR)ECS</sub>	Emitter-to-Collector Breakdown Voltage ④	18	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0A
ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Breakdown Voltage	—	1.13	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 2.5mA
V <sub>CE(ON)</sub>	Collector-to-Emitter Saturation Voltage	—	3.17	4.3	V	I <sub>C</sub> = 5.0A V <sub>GE</sub> = 15V
		—	4.04	—		I <sub>C</sub> = 11A See Fig.2, 5
		—	2.84	—		I <sub>C</sub> = 5.0A, T <sub>J</sub> = 150°C
V <sub>GE(th)</sub>	Gate Threshold Voltage	3.5	—	6.5		V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
ΔV <sub>GE(th)</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Threshold Voltage	—	-10	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1mA
g <sub>fe</sub>	Forward Transconductance ⑤	2.3	3.5	—	S	V <sub>CE</sub> = 100V, I <sub>C</sub> = 5.0A
I <sub>CES</sub>	Zero Gate Voltage Collector Current	—	—	250	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V
		—	—	2.0		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 10V, T <sub>J</sub> = 25°C
		—	—	1000		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V, T <sub>J</sub> = 150°C
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	±100	nA	V <sub>GE</sub> = ±20V

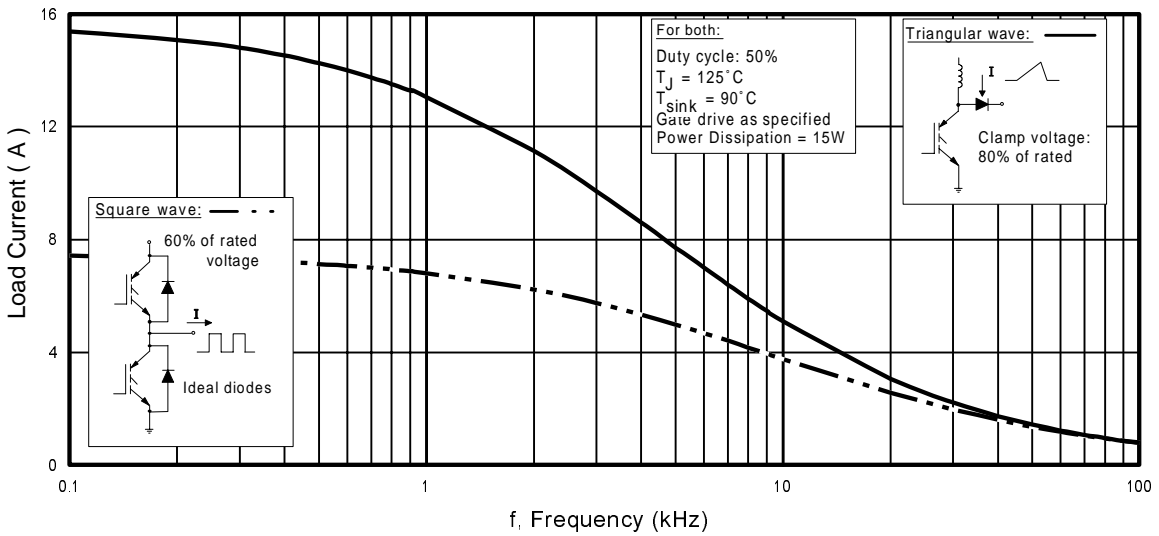
**Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	28	43	nC	I <sub>C</sub> = 5.0A
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	4.4	6.6		V <sub>CC</sub> = 400V See Fig.8
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	12	18		V <sub>GE</sub> = 15V
t <sub>d(on)</sub>	Turn-On Delay Time	—	23	—	ns	T <sub>J</sub> = 25°C I <sub>C</sub> = 5.0A, V <sub>CC</sub> = 960V V <sub>GE</sub> = 15V, R <sub>G</sub> = 50Ω
t <sub>r</sub>	Rise Time	—	26	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	93	140		
t <sub>f</sub>	Fall Time	—	270	400		
E <sub>on</sub>	Turn-On Switching Loss	—	0.45	—	mJ	Energy losses include "tail" See Fig. 9,10,14
E <sub>off</sub>	Turn-Off Switching Loss	—	0.44	—		
E <sub>ts</sub>	Total Switching Loss	—	0.89	1.2		
t <sub>sc</sub>	Short Circuit Withstand Time	10	—	—	μs	V <sub>CC</sub> = 720V, T <sub>J</sub> = 125°C V <sub>GE</sub> = 15V, R <sub>G</sub> = 50Ω
t <sub>d(on)</sub>	Turn-On Delay Time	—	23	—	ns	T <sub>J</sub> = 150°C, I <sub>C</sub> = 5.0A, V <sub>CC</sub> = 960V V <sub>GE</sub> = 15V, R <sub>G</sub> = 50Ω Energy losses include "tail" See Fig. 10,11,14
t <sub>r</sub>	Rise Time	—	28	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	100	—		
t <sub>f</sub>	Fall Time	—	620	—		
E <sub>ts</sub>	Total Switching Loss	—	1.7	—	mJ	
L <sub>E</sub>	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C <sub>ies</sub>	Input Capacitance	—	435	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V See Fig. 7 f = 1.0MHz
C <sub>oes</sub>	Output Capacitance	—	44	—		
C <sub>res</sub>	Reverse Transfer Capacitance	—	8.3	—		

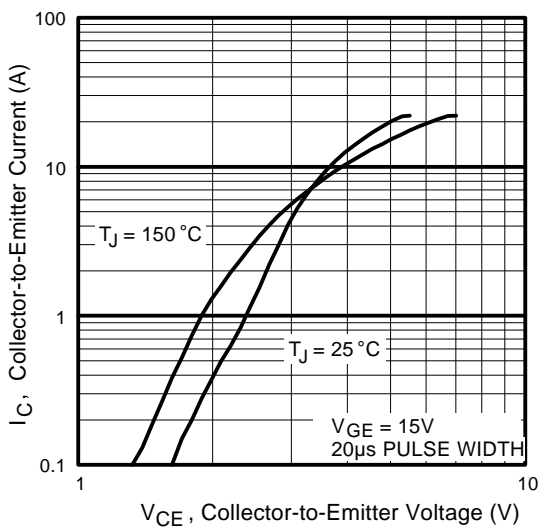
**Notes:**

- ① Repetitive rating; V<sub>GE</sub> = 20V, pulse width limited by max. junction temperature. ( See fig. 13b )
- ② V<sub>CC</sub> = 80%(V<sub>CES</sub>), V<sub>GE</sub> = 20V, L = 10μH, R<sub>G</sub> = 50Ω, (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width ≤ 80μs; duty factor ≤ 0.1%.
- ⑤ Pulse width 5.0μs, single shot.

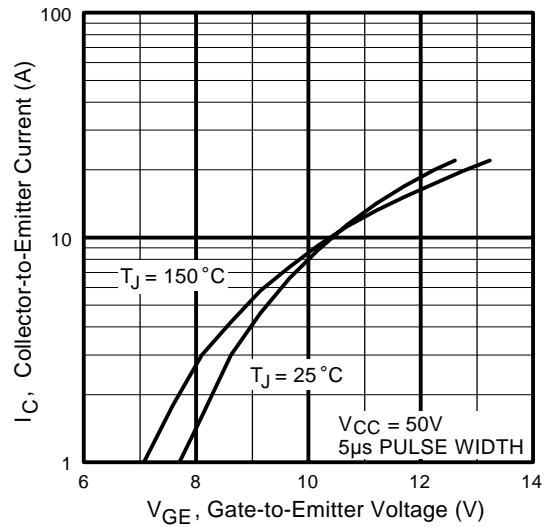
\* When mounted on 1" square PCB (FR-4 or G-10 Material ). For recommended footprint and soldering techniques refer to application note #AN-994.



**Fig. 1 - Typical Load Current vs. Frequency**  
 (Load Current =  $I_{\text{RMS}}$  of fundamental)



**Fig. 2 - Typical Output Characteristics**  
[www.irf.com](http://www.irf.com)



**Fig. 3 - Typical Transfer Characteristics**

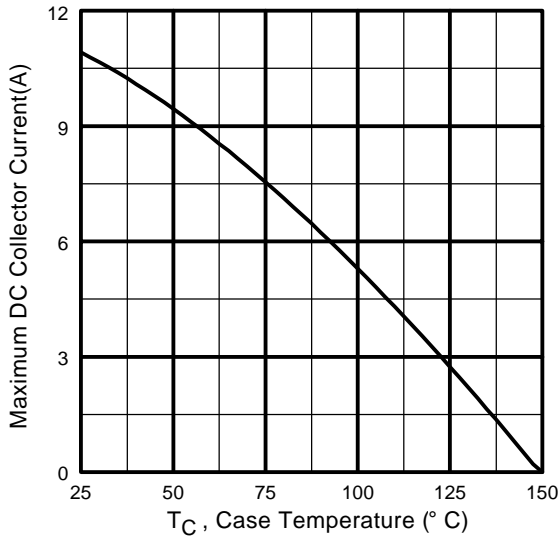


Fig. 4 - Maximum Collector Current vs. Case Temperature

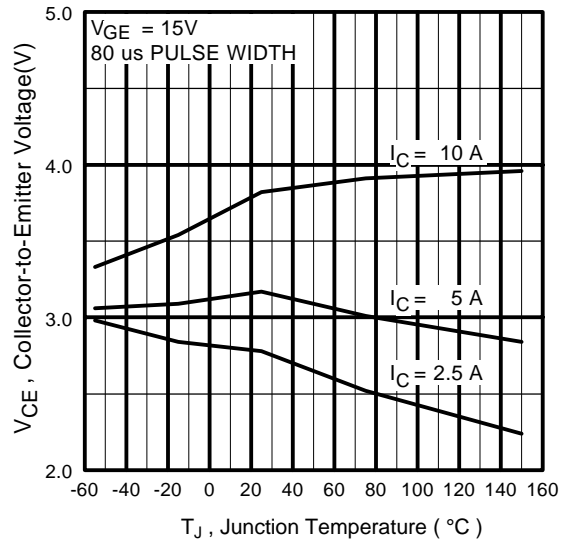


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

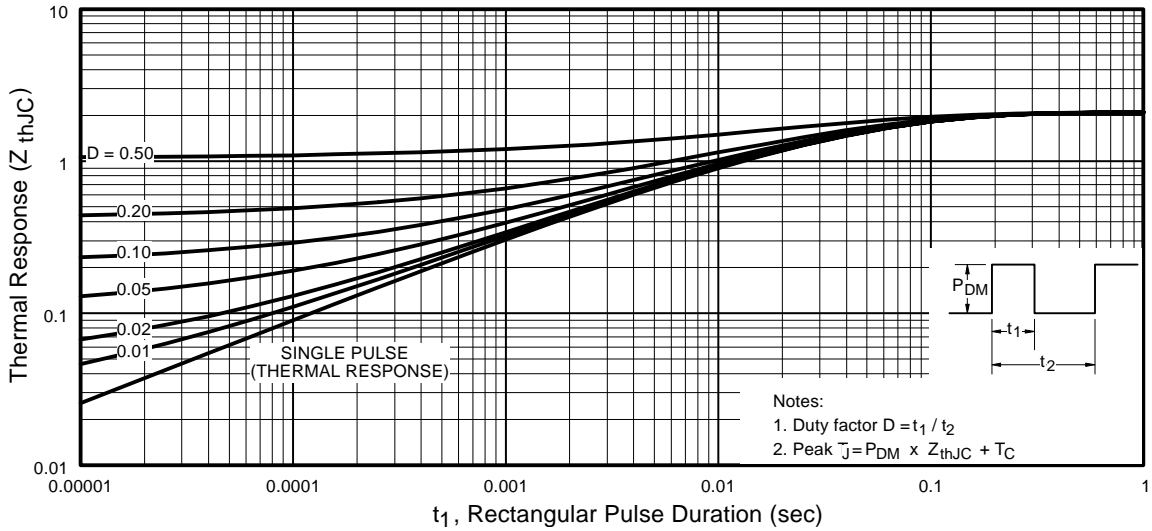
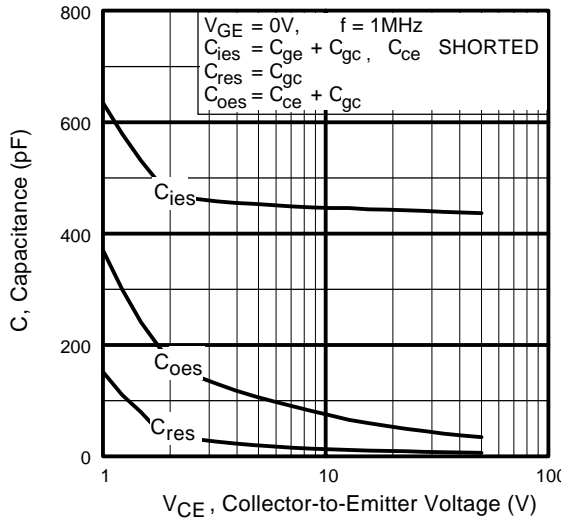
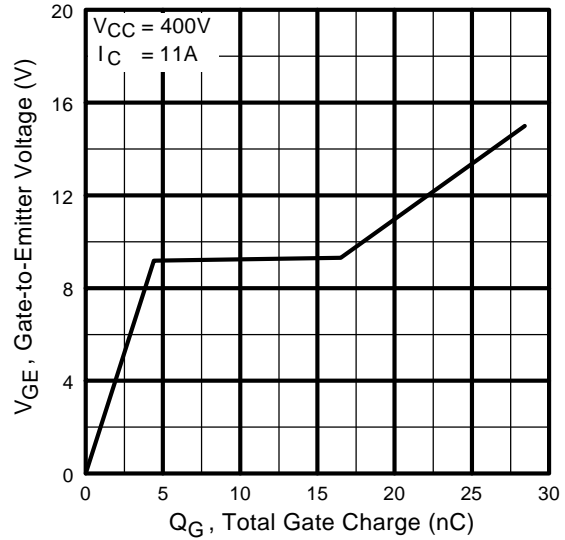


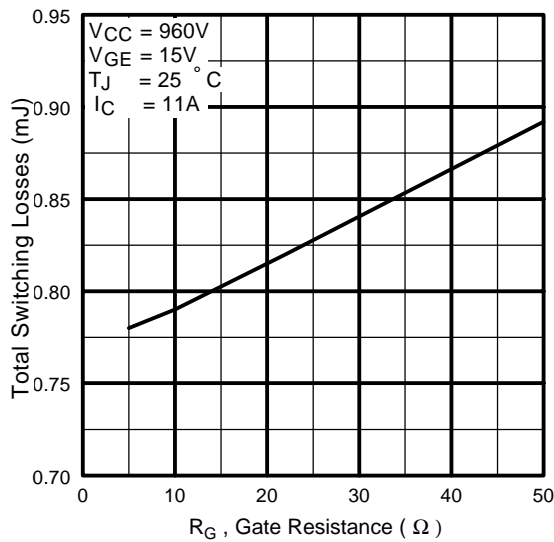
Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



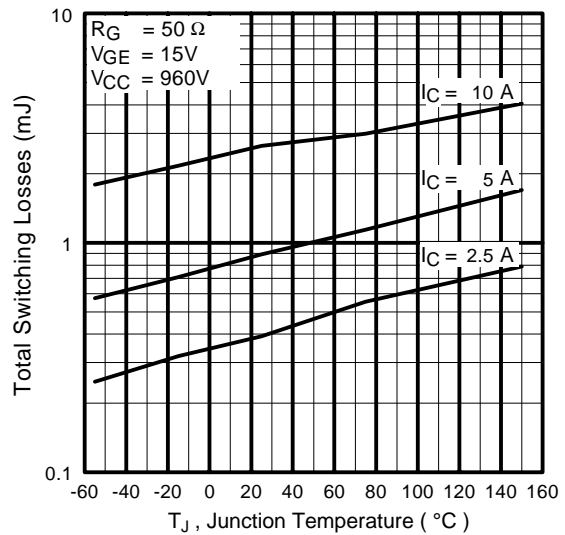
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

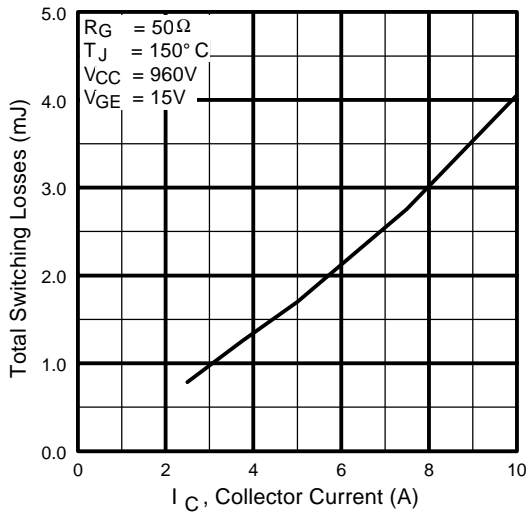


**Fig. 9** - Typical Switching Losses vs. Gate Resistance

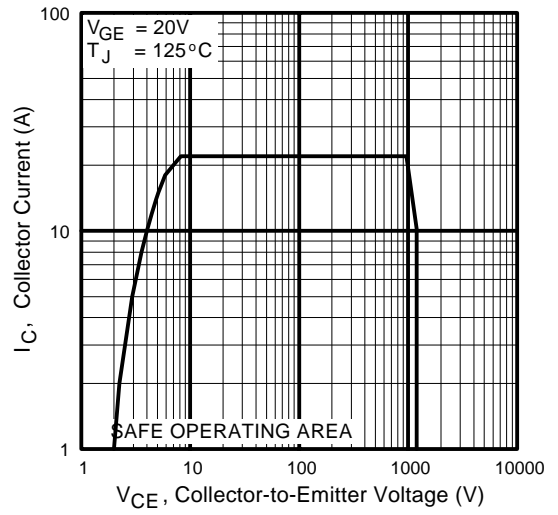


**Fig. 10** - Typical Switching Losses vs. Junction Temperature

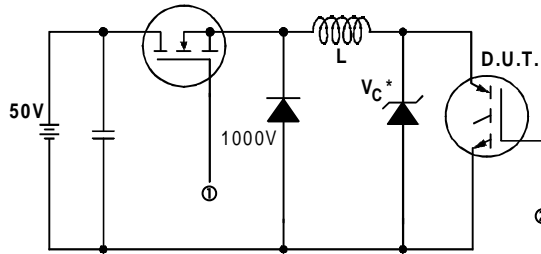
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**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current

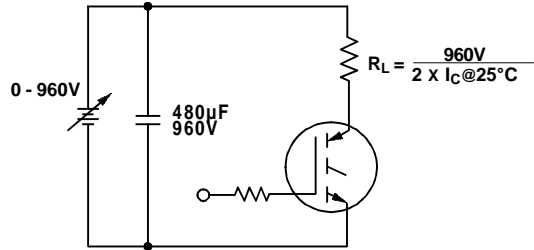


**Fig. 12** - Turn-Off SOA

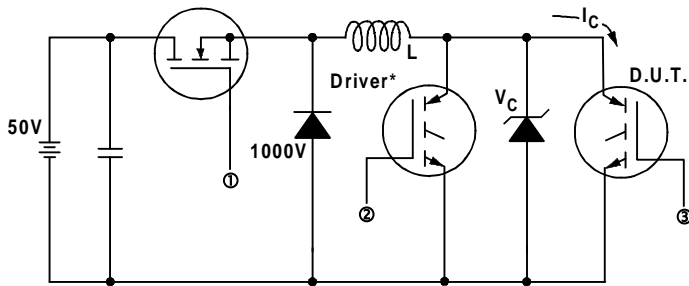


\* Driver same type as D.U.T.;  $V_c = 80\%$  of  $V_{ce(max)}$   
 \* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated  $I_d$ .

**Fig. 13a** - Clamped Inductive Load Test Circuit

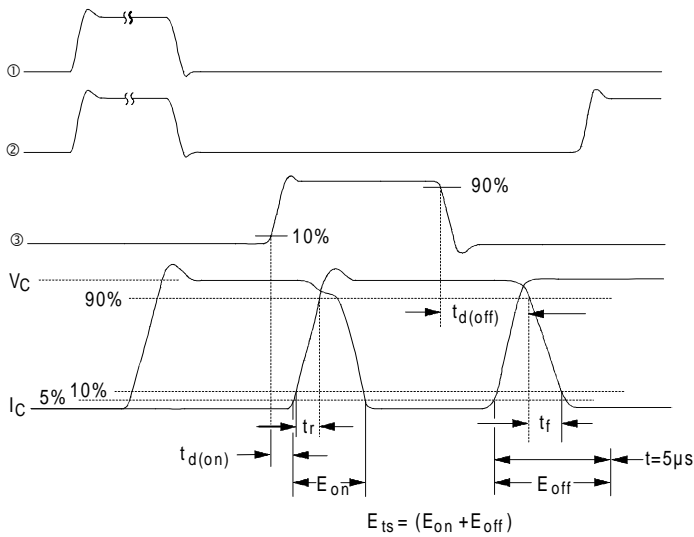


**Fig. 13b** - Pulsed Collector Current Test Circuit



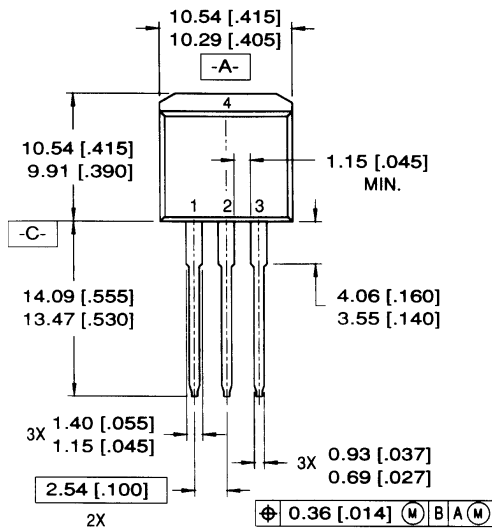
**Fig. 14a** - Switching Loss Test Circuit

\* Driver same type as D.U.T.,  $V_C = 960V$

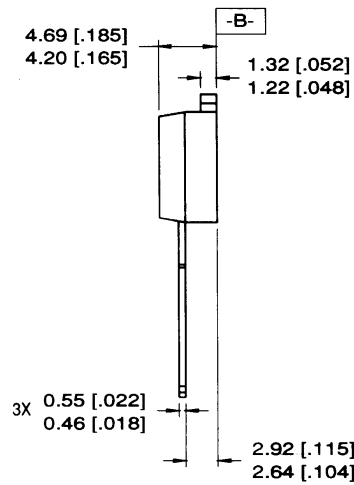


**Fig. 14b** - Switching Loss Waveforms

TO-262 Package Details



**LEAD ASSIGNMENTS**  
 1 = GATE      3 = SOURCE  
 2 = DRAIN    4 = DRAIN



NOTES:

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.